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ABSTRACT

An 18-month model distance learning program for rural middle and secondary school math and science teachers was developed by University of California Berkeley Extension in partnership with California rural educators. The program aimed to provide access to professional development for relatively isolated rural teachers in Del Norte, Humboldt, and Mendocino Counties on the north coast of California. The project began with a 1-week institute to familiarize a core group of teachers with the technologies to be used, to provide an overview of math and science teaching reforms in the state, and to introduce successful educational strategies that reduce unequal opportunities for students. During the school year, teachers took a distance learning course consisting of a weekly viewing of a videotaped instructor examining recent state reforms in science and math curriculum and instruction. Ongoing access to instructors, resource personnel, and each other was available via E-mail, fax, and telephone. Participants developed lesson plans, curricula, and projects consistent with the new guidelines. The following summer, participants were trained as mentors in mathematics and science reform; strategies to enhance access and equity in these areas; and technology-based access to new research, curricula, and teaching methods. The final program phase will put plans for access and equity in science and mathematics and model lesson plans on-line. Includes a description of the project's 10-hour distance learning course on access and equity in secondary math and science. (Author/TD)

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**Science and Mathematics Initiatives in Education:
A Model Distance Learning Program Building Telecommunications Bridges
To Rural Schools**

Susan Schatzman, Ph.D.
U.C. Berkeley
1995

**Submitted to
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ABSTRACT

University of California Berkeley Extension in partnership with educators in the California north coast counties of Del Norte, Humboldt and Mendocino, funded by the Toyota USA Foundation for an 18-month model distance learning program for middle school and secondary math and science teachers.

The project began with a one-week institute, held in the summer of 1994. The focus of the institute was to familiarize a core group of teachers with the technological delivery systems to be used in the project, to provide an overview of math and science teaching reforms; and to introduce some successful educational strategies that reduce inequalities of opportunities for students.

During the 1994-95 academic year, teachers are participating in technology-based, distance learning mathematics and science education courses, examining in detail the curricular and instructional changes outlined in the state science and math frameworks and recent teaching reforms. The course helped teachers develop lesson plans, curriculum units and thematic projects consistent with the new guidelines. Participants have ongoing access to course instructors, resource agency personnel, mathematicians, scientists, and other teacher-participants via computer email, fax and telephone calls.

Each week participating teachers viewed a taped featuring the course instructor as a moderator and co-presenter. Teachers participating in the project responded to the instructor regarding each session's "challenge" and were required to prepare a curriculum project which incorporated the tapes, readings, and communication with the project presenters.

The following summer, participating teachers were trained as mentors so that they could return to their schools as site trainers in mathematics and science reform, in strategies to enhance access and equity in these critical areas, and in technology-based access to new research, curricula and teaching methodology.

The final project was planned to be on line documents with model lesson plans and unit plans for access and equity in science and in mathematics in the middle school and secondary levels.

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The U.S. Congress Office of Technology Assessment defines distance learning as the "linking of a teacher and students in several geographic locations via technology that allows for interaction (1989)." At this time, this definition may be extended to include groups of students working collaboratively or cooperatively under the direction of a teacher, or groups of teachers receiving professional development and/or training. The two critical components of distance learning include one crucial element of good teaching -- interactivity -- and the fundamental element of distance learning -- multiple locations. What is missing from the early definition is time frame. The timing of distance learning is flexible depending on the mode in which it is delivered. It can be synchronous or asynchronous.

Although UC Berkeley Extension's service region extends from the San Francisco Bay area north through the rural coastal counties to the Oregon border, the distances involved have not permitted the close involvement with and continuing professional development for rural coastal teachers. The development of new distance learning technologies holds the promise of changing that situation. The relative isolation of these rural educators is most evident when it is necessary for them to drive an entire day to attend district or county training. Thus, changes in student lifestyles and demographics mandate alternative modes, places and times of instruction.

In partnership with rural classroom teachers and administrators, specialists in school reform, and professional mathematicians and scientists, UC Berkeley Extension Education Department established a model distance learning program for secondary teachers in rural areas, emphasizing curricula and computer methodologies that enhance learning and encourage access to on-line resources.

The project began with a summer institute to familiarize the participating teachers with teaching reforms, with successful educational strategies that reduce inequalities of opportunity for students that are created by such factors as gender, socioeconomic status, and ethnicity; and with the technological delivery systems that will be used in the project.

During the academic year, teachers participated in technology-based distance learning courses. Participants had ongoing access to resource personnel, mathematicians, and scientists via computer email, fax, and telephone conference calls. At time, on-line chat rooms and sessions were created for group discussion of a video and/or challenge assignment. The fall and spring courses included 10 hours of videotaped instruction, with one hour to be viewed during each weekly three-hour time block. The instructor then received assignments by email, fax, and/or telephone calls from the participants.

The following summer, the participants were trained as mentors in their districts to share the technology and to create on line resources and training throughout the schools and districts in math and science reform.

Barriers to Change

1. Though there were many quality mathematics and science teachers in place, there were no systematic links among them to share resources, curriculum units and student information.

2. Current assessment procedures were not appropriate to measure student achievement in the curriculum as it was changing.
3. Classrooms were not equipped with the technology nor adequately structured for the instructional formats needed in the teaching-learning process at the levels targeted by this project.
4. Continuing professional development opportunities and the mathematics and science programs at the state college and district level were not structured to foster interdisciplinary connections or to take advantage of technology.

Curriculum Reform in Math and Science

Much of the curriculum developed, both during the summer institute and the subsequent academic year and incorporated science concepts as bases for problem solving activities being developed for mathematics instruction. Since the 1960s, a series of curriculum reform movements have attempted to upgrade the teaching and learning of math and science in the public schools by shifting the focus of instruction from mechanical drill and practice, memorization of formulas and methods, to teaching for understanding. These projects focused on the development and dissemination of innovative teaching methods such as "hands-on science," inquiry oriented problem solving, conceptual understanding, critical thinking, active learning, integrated learning, and real world learning.

During each of the phases of the program, the materials developed, planned and presented included not only the modeling of techniques and content outlined but also included strategies for the encouragement of underrepresented populations, including ethnic minorities, young women, students with physical challenges and the poor who often leave the mathematics and science

programs at early ages. The intent, especially of the first academic semester, was to integrate programs that use both math and science concepts and the principles of classroom interaction that minimize inequitable treatment and restricted access of certain groups of students.

These reforms have been largely unsuccessful in changing the way mathematics and science was being taught and learned. More recently, state frameworks and the NCTM (National Council of Teachers of Mathematics) have published guides to these reforms along with suggestions for the sequencing of learning. The California State Frameworks also is a mandated curriculum guide for teachers of mathematics and science.

The NCTM standards provide similar emphases: "...present strategies for teaching may need to be reversed; knowledge often should emerge from experience with problems. In this way, students may recognize the need to apply a particular concept of procedure and have a strong conceptual basis for reconstructing their knowledge at a later date." The teacher's role in mathematics and science instruction requires major changes in many of the classroom techniques and the evaluation instruments for student progress need to reflect teaching practices. Teachers are then key figures in changing the ways in which math and science are taught and learned. These changes require that teachers have long term support, mentoring, and adequate resources.

Goals and Objectives

The project had the following objectives:

1. To provide greater access to technology resources by teachers and students in the three northern rural counties of California;
2. To use technology effectively to increase professional competence in math and science by familiarizing teachers with current state and national reforms;

3. To strengthen the quality of professional development courses for teachers in the area assigned to UC Berkeley Extension;
4. To bring together the resources of local government, education and business into partnerships that would benefit the schools long term;
5. To upgrade the math and science skills of the participants by providing access to new methods of teaching, problem solving and assessment;
6. To enhance effective support systems for underrepresented groups in all districts -- particularly in rural areas where social class often affects college attendance.

Needs Assessment and Evaluation

Planning this distance learning program included a needs analysis in which we determined that the technology used for training needed to be low technology, since we were seeking to put rural educators on line with each other with limited equipment and resources in the schools. External factors included the need for rural teachers to overcome both geographical boundaries and work time commitments.

Our needs assessment and preliminary visit to the school districts indicated a need for better cooperation among the local providers of professional development and the school curriculum developers. Also needed was better collaboration between the teacher education programs and the mathematics and science departments involved. Finally, both teacher education and mathematics and science programs needed to change the teaching approach in their classes to a more conceptually based form of teaching and the need to connect to exciting new resources available on line.

Specific evaluation activities were at several levels:

The Project level: The purpose of the project evaluation was to determine whether the total project met the stated goals. The test of this was how well the new curriculum reforms and assessment programs were understood and now a part of the teacher-participant's classroom design. Another test was the extent to which technology became available to all the teachers and students. Were the local districts providing the necessary support as promised? Was the public relations effort creating a positive environment for changed? Were there significant increases in the awareness of females, ethnic minorities in the higher level classrooms?

The Curriculum level: How did the teachers integrate the project curriculum with the California State Frameworks and the mathematics and science reforms? Did the project materials and presenters support the curricular goals of the project? Were the teachers better connected to the Bay area resources and projects and could they navigate on line in their subject areas?

The Classroom level: Resources and materials and training developed in the project had to ultimately be useable in the classroom. This depends, as stated earlier in the NCTM documents, on the teacher knowledge of the subject matter, classroom presentation methods and processes. Technology, application challenges and communication networks were specific outcomes of the classroom connections of the participants.

In addition to teacher development objectives, there were goals to expose students to work environments with various professional and to have contact with professional in math and science fields of research by putting them in contact with their teachers. Another goal was to give students a broad awareness of career opportunities and the skills necessary to perform those careers.

Finally, part of the grant requirement were to evaluate the project and program through

participation in conferences and helping the participants become mentors in their districts. School districts themselves have made major efforts to use the technology they have despite their lack of adequate funding in this critical area. The evidence clearly shows that this kind of training is desperately needed by our children to prepare them for the challenges they will face in our heavily technology-reliant society. Such a need has been demonstrated on all levels and by both educational and legislative agencies. The level of technology funding in the state was minimal at the time the project started and expanded once the Education First initiative went into place from Pacific Bell, a year and a half later.

The State of California Technology plan has also made strong recommendations regarding better use of instructional technology and has encouraged schools and districts to develop state-of-the-art technology models, to improve the information technology network, to develop plans to integrate the use of technology in instruction and management and to analyze current and projected services provided through educational technology.

Sample Curriculum

TEACHING REFORM IN SECONDARY MATH AND SCIENCE: ISSUES OF ACCESS AND EQUITY X354.6

COURSE DESCRIPTION

This course is a distance learning course for the project, Access and Equity in Science and Mathematics: A Model Distance-Learning program for Secondary Teachers. The course includes 10 hours of videotaped instruction, with one hour to be viewed during each weekly 3-hour class meeting. The instructor will then be available to take e-mail, faxes, and telephone calls from students.

This course is designed to present new programs and initiative in science and mathematics education emphasizing equity and access issues within these subjects.

COURSE OBJECTIVES

Integrate knowledge of access issues into math and science courses for teachers

Provide course work on new initiatives in math and science teaching

Incorporate teaching strategies and materials which address equity into math and science courses

Provide ongoing development of a local resource guide in science and math education

Session 1: Scope and Sequence of Secondary Math and Science

This session incorporates discussions and demonstrations of new initiatives in science and math education including the Scope and Sequence program in California. A guest speaker will discuss the strong points and potential issues involved in this program and demonstrate innovative techniques such as guess and check that allow students with English as a second language and learning disabilities to perform math functions. Another topic covered is the assignment of problems in class that are meaningful and correspond to real life situations. Also discussed are the new assessment techniques corresponding to the changes in the frameworks in mathematics and science and some implications for changes in classroom teaching methods.

Session 2: Theme-based Instruction in Math and Science: issues of access and equity

Theme-based instruction requires access to significant resources for both the teacher and the students. The guest speaker is the state president of Computer Using Educators (CUE). Definitions of access and equity will be covered. Technologies in Education broaden access to resources and create more equitable learning environments. Specific cases of gender, disabled, and under represented groups in math and science will be presented. Role playing of urban and rural teachers in dialogue with state legislators will uncover some meaningful solutions to access and equity issues in math and science. With ever growing access, physical and intellectual property rights, the right to privacy, and the limitation on rights of free expression will be discussed.

Case Study: Deaf Penpals: Communication on Fredmail

Challenge: Reflect on what has been covered in this session and choose an area of focus. Select rural/urban issues, gender equity, accessibility for disabled students, or any issue that interests you. Write a 2 to 3 page paper describing the situation you have chosen in your own classroom setting and what you might do to remedy or begin to solve the problem.

Session 3: Integrating Cultural Perspectives in Mathematics and Science

Panel presentations of various cultural perspectives by culture specialists who formerly presented in a Critical Issues Forum for the Extension Education Department will be the presenters for this session. They will also discuss how teachers may implement these perspectives into the teaching of science and mathematics. Different learning styles and cultural perspectives will be discussed and demonstrated. This will be followed by a question and answer session. Topics covered include sex role stereotyping, numbers in other languages, symbols (geometry and measurement), games of chance in cultures and strategies. Exploring an anti-bias approach to curriculum improvement, math, equity and economics are covered as issues regarding success in society.

Challenge: Examine a current front-page news story. Consider how this story might be viewed from the perspective of different groups. Some group comparisons you might consider are male/female; race/ethnic; age; income. Write a 2 to 3 page response to the story from two different perspectives.

Session 4: The Interactive Mathematics Program

In this session, representatives from the Interactive Mathematics Program including two classroom teachers and the California Project Coordinator will review and discuss the history and goals of the Interactive Math Program. Demonstrations will be given of student portfolio work and the creation of technical guides in the classroom. The initiative which promotes meaningful classroom activity is demonstrated as the technical guides the students have created are compared to real world engineering and computer technical manuals. Another important feature of this program is that the curricula is created so that every student has an entry point. Various problems and their levels are demonstrated and students will view a video demonstrating a teacher facilitating a theme based interdisciplinary project, "the Pit and the Pendulum," and a classroom measuring shadows on the wall will be shown to demonstrate the high involvement of students.

Session 5: the GESA approach to Access and Equity

GESA (Gender/Ethnic Expectations and Student Achievement) teaches teachers to reduce the disparity in their teacher/student interaction by examining their own biases, as demonstrated by their own behavior toward students. Curricular changes are then discussed that assure more equitable treatment and the five GESA units are covered including instructional contact, grouping and organization, classroom management, self esteem issues and evaluation. Issues of multiculturalism and pluralism are discussed as well as the particular applications to mathematics, science and technology.

Session 6: A State Perspective on New initiatives

During this session, the Executive Director of the California Science Project will discuss the new

initiatives in the State of California, their history and what these programs have meant for the California science project. A math teacher working on state assessment projects will then discuss the Frameworks, Math A&B, Change from Within, the Math Renaissance, and Replacement units. Both presenters will discuss integrating these reforms into classroom teaching.

Demonstration: a mini-lesson showing math shortcuts, guess and check, balance and estimation will then be demonstration indicating the new ways to teach these topics and comparing them to the traditional methods.

Session 7: A National Perspective on New Initiatives

A time line of national reforms beginning with a brief overview of 100 years of school reform from 1883 - mid 1990s is presented. Then, specific reforms on a national level beginning with the Nation at Risk in 1983 are discussed. Science and Mathematics organizations, also, have proposed significant changes in the teaching and learning of their subjects and these reforms are summarized. Following this, a discussion of the changing national demographics as well as alternative ways for teachers and students to enter into the science and mathematics fields and to form interest groups such as WISC, WISE, SWIE, EYH, Adopt a Magnet, Bridge programs, the Science Dome Project and Mentor Programs. The guest speaker will share her experiences entering the field of mathematics later in her life and will discuss what reform has meant in the classroom and the changes in teaching styles and learning outcomes over the last two decades.

Session 8: Careers in Math and Science - Issues of Access and Equity

During this session two scientists from the Lawrence Livermore Laboratory will discuss their careers. One is an astrophysicist and the other an engineer and head of a work group. They will talk about the education needed to get where they got, the day to day experiences on the job, how their profession integrates with their lifestyle and issue a challenge to teachers and students to continue taking math and science courses throughout school to keep their options open. Along with these presentations, the Workforce 2000 program will be presented demonstrating society's goals for mathematically and scientifically literate workers. Industry's expectations for the educational community are discussed and the question of whether we are preparing the students in the state for the future are discussed by the panelists.

Session 9: Rural Education Access and Equity in Math and Science

Access and equity issues in rural education are discussed. Model projects in rural settings will be demonstrated. Panelists will discuss funding for the model projects. Particular issues for rural educators and a question and answer session among panelists will present ways for rural educators to access resources in other areas.

Session 10: Summary and Project Sharing

This session will include the sharing and review of each of the participants projects for the semester.

COURSE EVALUATION

RSQC Summaries	10
Challenges	40
Project	40
Weekly connections	10
	100 %

Challenges: Spend two hours developing a response to the challenge using the video, the readings and one other resource to support this material. (for each session)

REQUIRED READING

Harris, Judy, Way of the Ferret, ISTE 1993.

Caught in the Middle: Educational Reform for Young Adolescents in California Public Schools, California Department of Education, 1987.

Second to None: A Vision of the New California High School, California Department of Education, 1992.

Mathematics Framework for California Public School: Kindergarten through Grade Twelve, California State Board of Education, 1990.

Science Framework for California Public Schools: Kindergarten through Grade Twelve, California Department of Education, 1990.

Sadker, Myra and David, "Sexism in the Classroom: From Grade School to Graduate School," from Phi Delta Kappan, March 1986.

Molesky-Poz, Jean and Margaret Wilcox (eds), Cultural and Language Diversity in California Classrooms (selected sections), University of California Berkeley Education Extension, 1992.

OPTIONAL READING

Bigelow, Bill, Linda Christensen, Stan Karp, Barbara Miner, and Bob Peterson (eds), Alabama: Rethinking Our Classrooms: Teaching for Equity and Justice, Rethinking Schools, Ltd., 1994.

Lee, Enid, Letters to Marcia: a Teacher's Guide to Anti-Racist Education, Toronto: Cross Cultural Communication Centre, 1992.

Deloria, Vine, Jr., Indian Education in America, Colorado: American Indian Science and Engineering Society, 1991.

SCRIPT FOR THE VIDEO: EQUALS, FAMILY MATH, (& MATH/SCIENCE NETWORK)

Run Time	Key Points	Presenter	Methods/ activity	Visuals/ Prompter	Support materials
.5 min.	Intro.			Slate #1: "Terri Belcher..." Slate #2: "Grace Coates..."	
2 min.	3 Startling Statements		Ask the questions: jot down the answers	Slate #3: Startling Statement 4 Slate 4: Startling Statement 9 Slate 5: Startling Statement 12 Slate #6: Startling Statement 14	
1 min.	History of EQUALS	T. Belcher			
2 min.	What is EQUALS about:				
	A.C.E.			Slate #7A "A.C.E."	
	Awareness and Access			Slate #7B: "Awareness..." added	
	Competence and Confidence			Slate #7C: "Competence..." added	
	Encouragement and Equity			Slate #7D: "Encouragement..." added	

2 min.	Our Program				
	EQUALS workshops series			Photo Collage:	
	Description			Display 1: Manipulatives on a Table:	Photos sent
				Slate #8: "The next EQUALS..."	
	EQUALS contract workshop			Slate #9: "Contract EQUALS..."	
	SEQUALS				
	Description				
	This year's series offering				
	FAMILY MATH & MPF				
	FAMILY SCIENCE				
3 min.	Our Publications				
	Old:			Display #2: on table:	
				Math for Girls	
				Assessment	
				Alternatives	
				Teachers Voices	
				Spaces	
				Get it Together	
				101 Problems	
	New:			Investigations	

4 min.	Startling Statement Answers		Show original question Show answer with small question Comment	Slate # 10: "Answer to...4" Slate #11 : "Answer to...9" Slate # 12: "Answer to...12" Slate #13 : "Answer to ...14"	
1 min.	Read comment cards			will read from cards	Terri will bring these with her
.5 min.	How you can participate			Slate #14: "For more information..."	
15 min.	FAMILY MATH & MPF FAMILY SCIENCE	Grace's Portion			see Grace
25 min.	Discussion and/or activities	Shaylor Coates Belcher			
1 min.	The Challenge: EQUALS	Belcher/ Shaylor		Slate #15: "The EQUALS challenge..."	
1 min.	The Challenge: FAMILY MATH	Coates/ Shaylor			see Grace
1 min.	Closing				

* Grace and I can easily cut 5 minutes from our presentations if Becky Failor is able to join us.

If you have questions, please call at (W) 510-642-1823 or (H) 515-525-5014.